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JULY 1993

REPORT NO. 93-21

COMMERCIAL WEB STRAPS
AND CHAIN METHODS OF
SECUREMENT FOR
JOINT SERVICES ROAD TEST

94-19931



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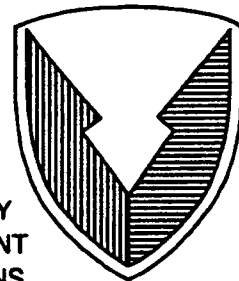
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22a. NAME OF RESPONSIBLE INDIVIDUAL JEROME H. KROHN			22b. TELEPHONE (Include Area Code) 815-273-8929		22c. OFFICE SYMBOL SMCAC-DEV

**U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
VALIDATION ENGINEERING DIVISION
SAVANNA, IL 61074-9639**

REPORT NO. 93-21

**COMMERCIAL WEB STRAPS AND CHAIN METHODS OF SECUREMENT FOR JOINT
SERVICES ROAD TEST**

JULY 1993

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PART 1

INTRODUCTION

A. **BACKGROUND.** The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by USADACS, Transportation Engineering Division (SMCAC-DET), to test procedures for securing ammunition loads with chains and load binders using short lengths of rejected lined fire hose in place of doubled 2- by 6-inch chain boards, commercial web straps with winches furnished by Tri-State Motor Transit, and commercial web strap assemblies.

B. **AUTHORITY.** This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. **OBJECTIVE.** The primary objective of this test was to assess the ability of commercially available web straps and to secure ammunition loads during the transportation cycle. The secondary objective was to determine whether using fire hose, as an anti-chafing material, would protect ammunition containers from damage when restrained with chains and load binders.

D. **CONCLUSION.** As tested, the commercial web strap assemblies, the commercial web straps with winches, and the chains and load binders with fire hose used to replace dunnage successfully passed transportability testing. The commercial web strap with winch displayed some deficiencies, such as rotational movement of the winch on the truck bed due to bending of the winch mounting bracket (see part 6, pages 6-2 and 6-3). The small amount of deformation displayed during a single series of testing did not warrant failure.

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E. RECOMMENDATIONS:

1. The commercial web strap with winch should have two set screws in the winch mounting bracket in order to counter the movement caused by the strap on the winch.
2. The strength of the winch mounting bracket on the commercial web strap with winch should be increased.
3. The commercial web strap with winch may be improved upon also by increasing the hardness of the mounting bracket set screws.

PART 2

JULY 1993

ATTENDEES

Jason B. Solberg
General Engineer
DSN 585-8079
815-273-8079

William R. Frerichs
Supervisory General Engineer
DSN 585-8071
815-273-8071

Richard S. Haynes
Industrial Engineering Technician
DSN 585-8225
815-273-8225

Ralph A. Arnold
Industrial Engineering Technician
DSN 585-8073
815-273-8073

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

PART 3

TEST PROCEDURES

TRANSPORTABILITY TESTS. The test procedures outlined in this section were extracted from TP-91-01, Transportability Testing Procedures. This standard identifies six steps that a load must undergo if it is considered to be acceptable. The three tests that were conducted on the test specimen are synopsized below.

A. **ROAD HAZARD COURSE.** The specimen was subjected to the road hazard course. Using a suitable truck/tractor or tactical vehicle, the vehicle/specimen was towed/driven over a hazard course two times at a speed of approximately 5 mph. The speed was increased or decreased, as appropriate, to produce the most violent load response.

B. **ROAD TRIP.** Using a suitable truck/tractor and trailer, or tactical vehicle, the tactical vehicle/specimen load was driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. Test route included curves, corners, railroad crossings, cattle guards, stops and starts. The test vehicle traveled at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. This step provides for the tactical vehicle/specimen load to be subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 degree grade. The first three stops were at 5, 10, and 15 mph, while the stop in the reverse direction was at approximately 5 mph.

C. **WASHBOARD COURSE.** Using a suitable truck/tractor, and/or tactical vehicle, the specimen was towed/driven over the washboard course at a speed which produces the most violent response in the particular test load.

PART 4

TEST EQUIPMENT

A. TEST LOAD.

- | | |
|-----------------|------------------|
| 1. Container. | CNU-305/E |
| 2. Unitization. | 4 high by 2 wide |

B. TEST LOAD.

- | | |
|-----------------|------------------|
| 1. Container. | LANCE M599 |
| 2. Unitization. | 2 high by 2 wide |

C. TEST LOAD.

- | | |
|-----------------|--------------------------|
| 1. Container. | 2,000-pound bomb pallets |
| 2. Unitization. | 2 high by 2 wide |

D. TEST LOAD.

- | | |
|-----------------|------------------|
| 1. Container. | CNU-123/E |
| 2. Unitization. | 3 high by 4 wide |

E. TEST LOAD.

- | | |
|-----------------|------------------|
| 1. Container. | MLRS pods |
| 2. Unitization. | 2 high by 2 wide |

F. M871 SEMITRAILER.

- | | |
|------------------|------------------------------|
| 1. Manufacturer. | Southwest Truck Body Company |
| 2. Platform. | 40-foot long |

PART 5

TEST RESULTS

TRANSPORTABILITY TESTS.

A. First, a load of CNU-305/E containers was restrained by commercial web straps and winches furnished by Tri-State Motor Transit and tested (see part 6, page 6-4). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.89	2.30
HAZARD COURSE #2	00:24.39	2.35
30-MILE ROAD TRIP	39:00.00	46.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.31	2.36
HAZARD COURSE #4	00:24.54	2.33
WASHBOARD COURSE	01:14.08	1.84

No damage or movement was noted during this test.

B. Next, the CNU-305/E containers were restrained by commercial web strap assemblies (see part 6, page 6-5). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:23.39	2.45
HAZARD COURSE #2	00:24.27	2.36
30-MILE ROAD TRIP	42:00.00	43.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.88	2.30
HAZARD COURSE #4	00:25.13	2.28
WASHBOARD COURSE	01:12.09	1.89

No damage or movement was noted during this test.

C. The CNU-305/E containers were then restrained with chains and load binders with rejected fire hose to replace dunnage (see part 6, page 6-6). The times and speeds the load was tested at are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.59	2.33
HAZARD COURSE #2	00:24.95	2.30
30-MILE ROAD TRIP	42:00.00	43.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.45	2.34
HAZARD COURSE #4	00:25.00	2.29
WASHBOARD COURSE	01:11.25	1.91

No damage or movement was noted during this test.

D. A load of LANCE M599 containers was then restrained by chains and load binders with rejected fire hose as a replacement for dunnage (see part 6, page 6-7). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:25.33	2.26
HAZARD COURSE #2	00:24.97	2.29
30-MILE ROAD TRIP	42:00.00	43.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.69	2.32
HAZARD COURSE #4	00:25.17	2.28
WASHBOARD COURSE	01:14.80	1.82

No damage or movement was noted during this test.

E. A load of 2,000-pound bombs was then restrained by commercial web strap assemblies (see part 6, page 6-8). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.70	2.32
HAZARD COURSE #2	00:25.37	2.26
30-MILE ROAD TRIP	46:00.00	39.00

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.58	2.33
HAZARD COURSE #4	00:25.75	2.22
WASHBOARD COURSE	01:13.16	1.86

No damage or movement was noted during this test.

F. The 2,000-pound bombs were then restrained by commercial web straps and winches furnished by Tri-State Motors (see part 6, page 6-9). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:25.03	2.29
HAZARD COURSE #2	00:25.04	2.29
30-MILE ROAD TRIP	50:00.00	36.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.59	2.33
HAZARD COURSE #4	00:25.09	2.28
WASHBOARD COURSE	01:12.24	1.89

No damage or movement was noted during this test.

G. The 2,000-pound bombs were then restrained by chains and load binders with rejected fire hose as a replacement for dunnage (see part 6, page 6-10). The times and speeds recorded to traverse each course are shown below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.65	2.32
HAZARD COURSE #2	00:24.73	2.32
30-MILE ROAD TRIP	45:00.00	40.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.52	2.34
HAZARD COURSE #4	00:24.68	2.32
WASHBOARD COURSE	01:12.00	1.89

No damage or movement was noted during this test.

H. A load of CNU-123VE containers was then restrained by commercial web strap assemblies and tested (see part 6, page 6-11). The times and speeds recorded to traverse each course are shown in order of sequence below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.70	2.32
HAZARD COURSE #2	00:24.69	2.32
30-MILE ROAD TRIP	42:00.00	43.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.46	2.34
HAZARD COURSE #4	00:24.57	2.33
WASHBOARD COURSE	01:10.54	1.93

The containers moved laterally in opposite directions while traversing the hazard course; thus, producing a 1/8-inch gap between the containers at the rear. No damage or movement was noted during this test.

I. The CNU-123VE containers were then restrained by commercial web straps and winches furnished by Tri-State Motors (see part 6, page 6-12). The times taken to traverse each course are shown in order of sequence below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:24.92	2.30
HAZARD COURSE #2	00:24.67	2.32
30-MILE ROAD TRIP	44:00.00	41.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.46	2.34
HAZARD COURSE #4	00:24.50	2.34
WASHBOARD COURSE	01:09.38	1.97

No damage or movement was noted during this test.

J. A load of MLRS pods was then restrained by commercial web strap assemblies and tested (see part 6, page 6-13). The times and speeds recorded to traverse each course are shown in order of sequence below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:25.17	2.28
HAZARD COURSE #2	00:24.78	2.31
30-MILE ROAD TRIP	42:00.00	43.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:24.67	2.32
HAZARD COURSE #4	00:24.71	2.32
WASHBOARD COURSE	01:10.71	1.93

No damage or movement was noted during this test.

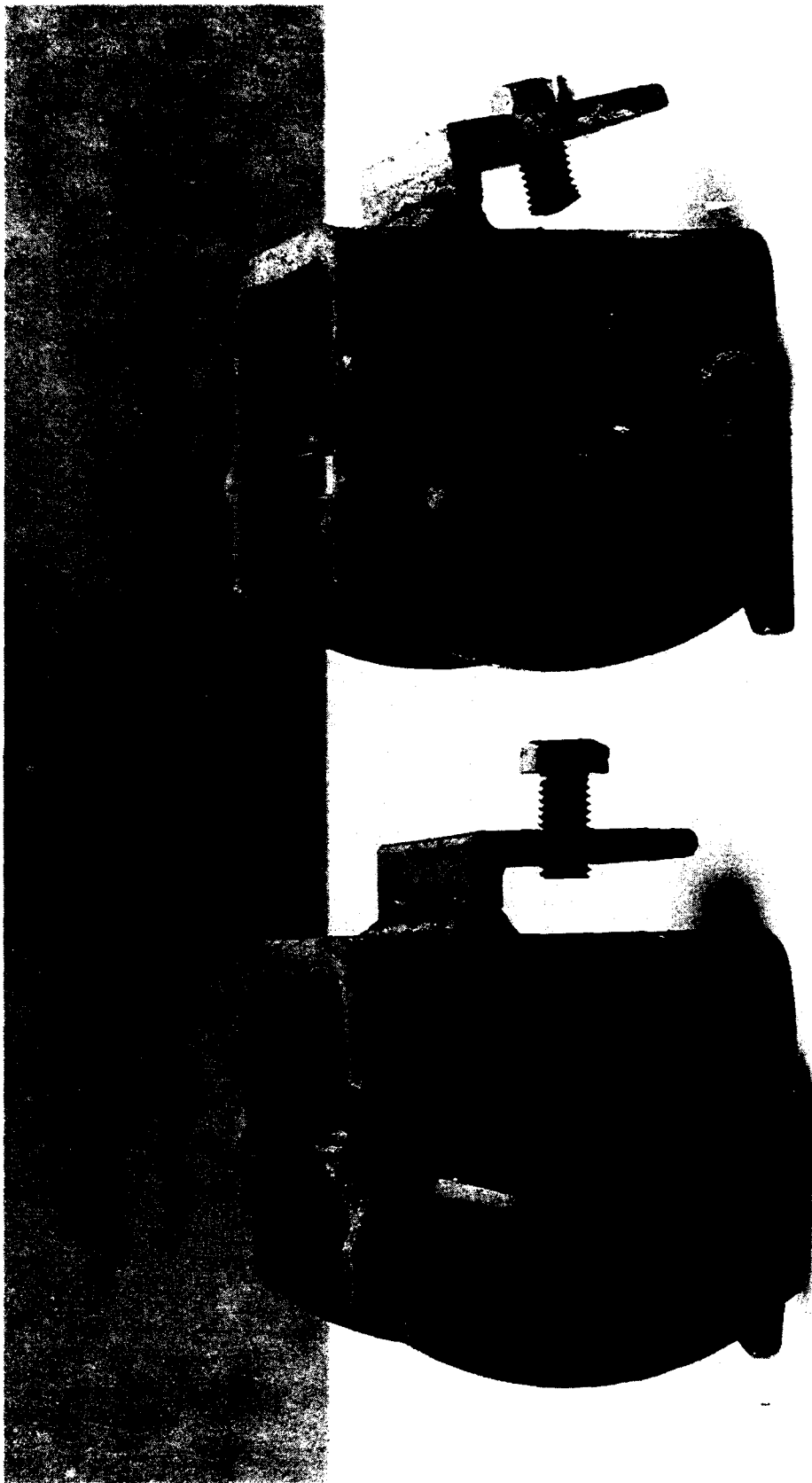
K. The MLRS pods were then restrained by commercial web straps and winches furnished by Tri-State Motors. One new-condition winch was used over the rear axle of the M871 semitrailer. The times and speeds recorded to traverse each course are shown in order of sequence below.

<u>COURSE</u>	<u>TIME (min:sec)</u>	<u>SPEED (mph)</u>
HAZARD COURSE #1	00:25.56	2.24
HAZARD COURSE #2	00:24.96	2.29
30 MILE ROAD TRIP	44:00.00	41.00
PANIC STOPS	5, 10, and 15 in forward; 5 in reverse	
HAZARD COURSE #3	00:25.11	2.28
HAZARD COURSE #4	00:25.37	2.26
WASHBOARD COURSE	01:10.27	1.94

No damage or movement was noted during this test.

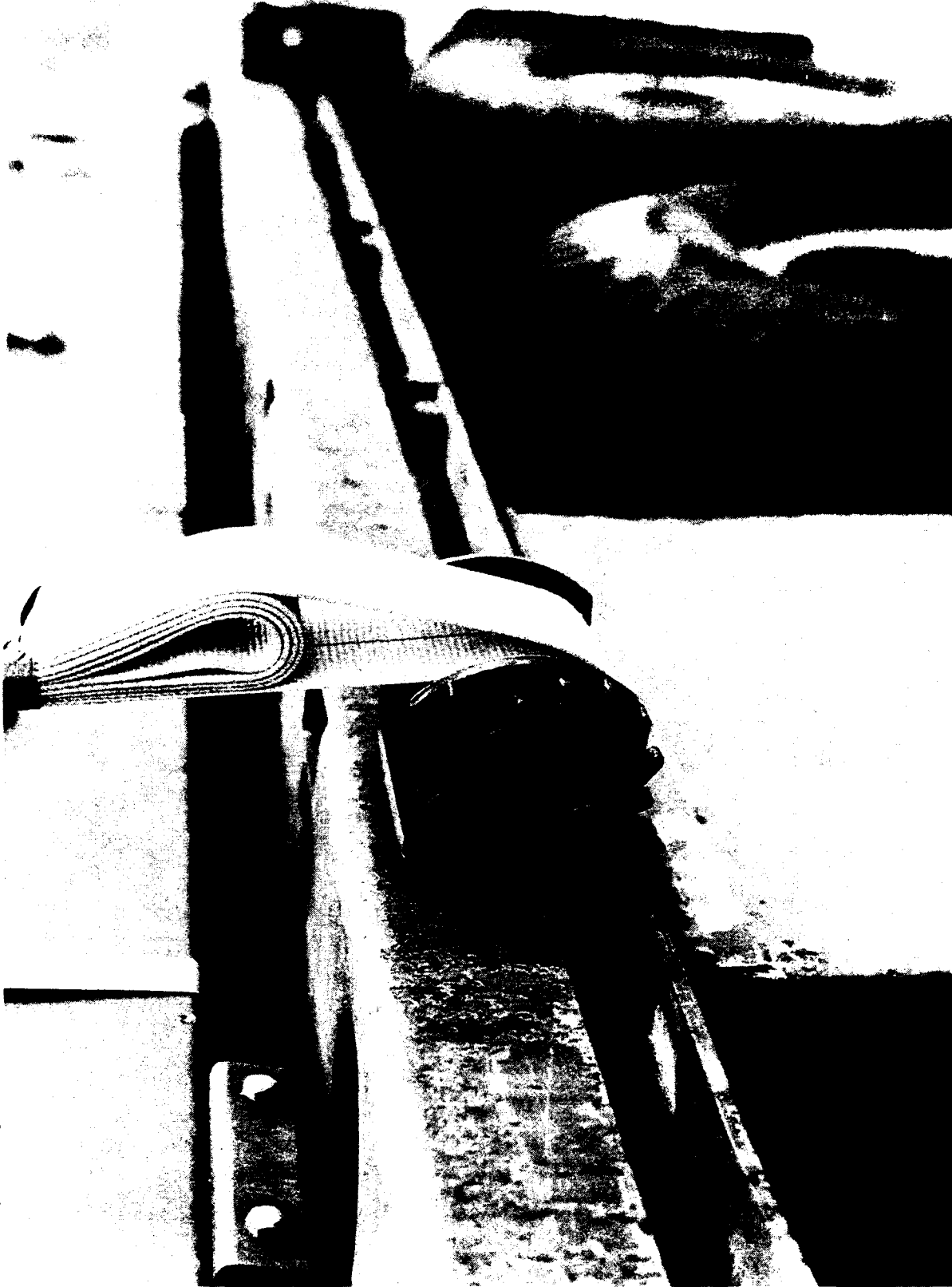
PART 6

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. 3146. This photo shows the spreading of the mounting bracket which occurred on a winch during testing as compared to an untested winch.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. AO317-SCN-94-047-3084. This photo shows the typical arrangement of the winch used with commercial tie-down straps.



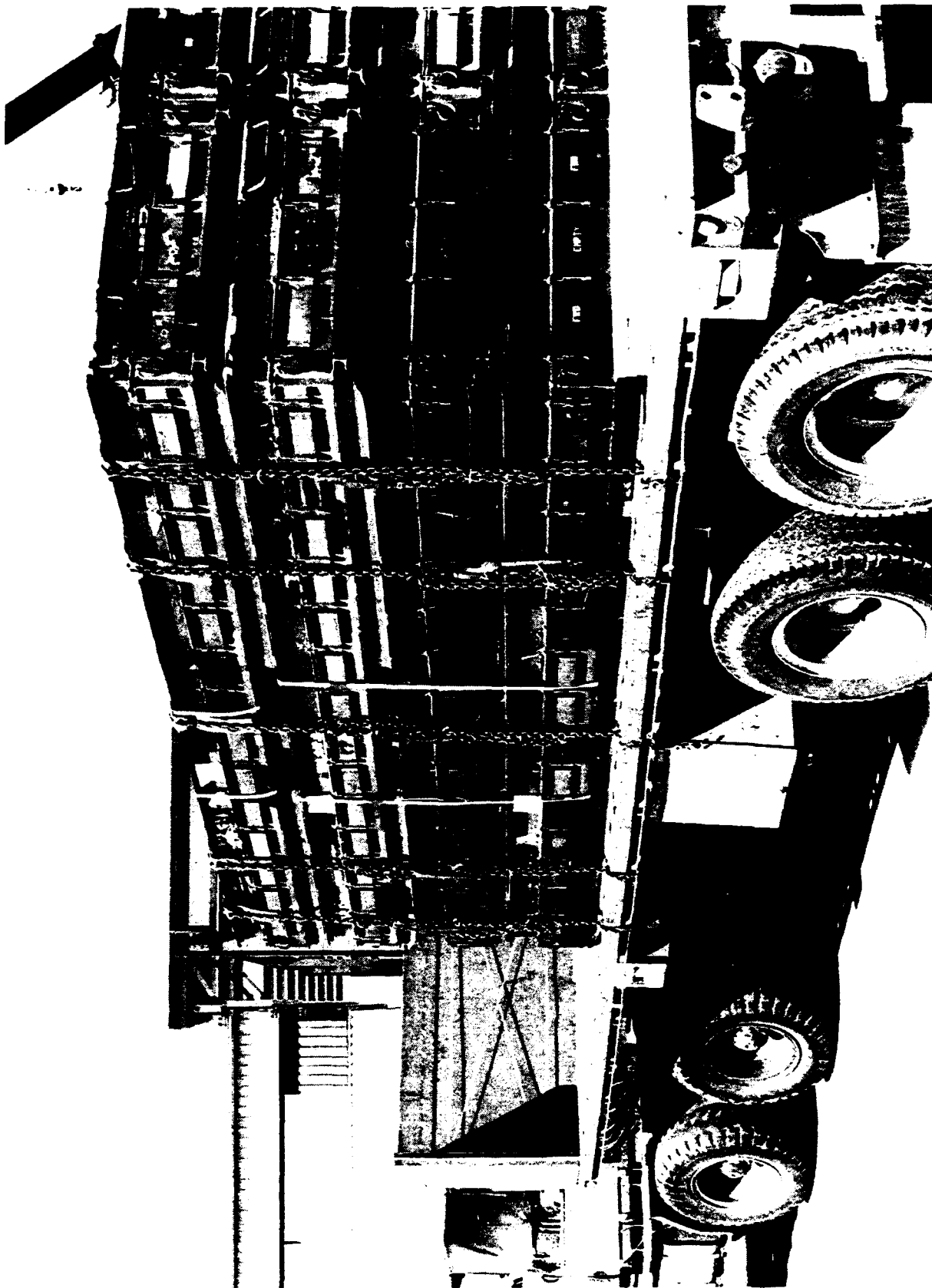
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Photo No. AO317-SCN-94-047-3053. This photo shows the CNU-305/E load restrained with commercial tiedown straps with winches.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3042. This photo shows the CNU-305/E load restrained with commercial web strap assemblies.



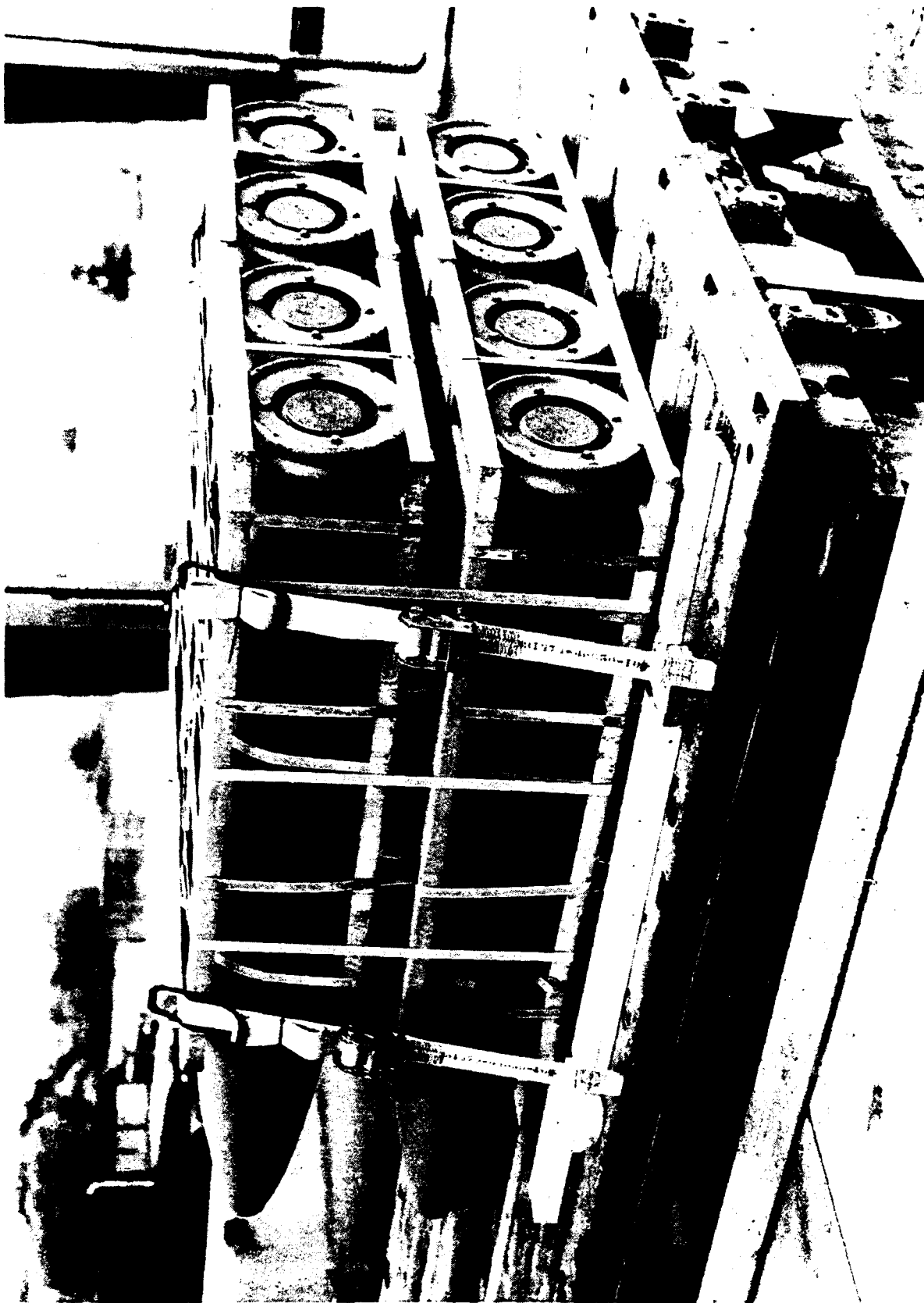
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AO317-SCN-94-047-3038. This photo shows the CNU-305/E load restrained with chains and load binders with rejected fire hose used to replace chain board dunnage.



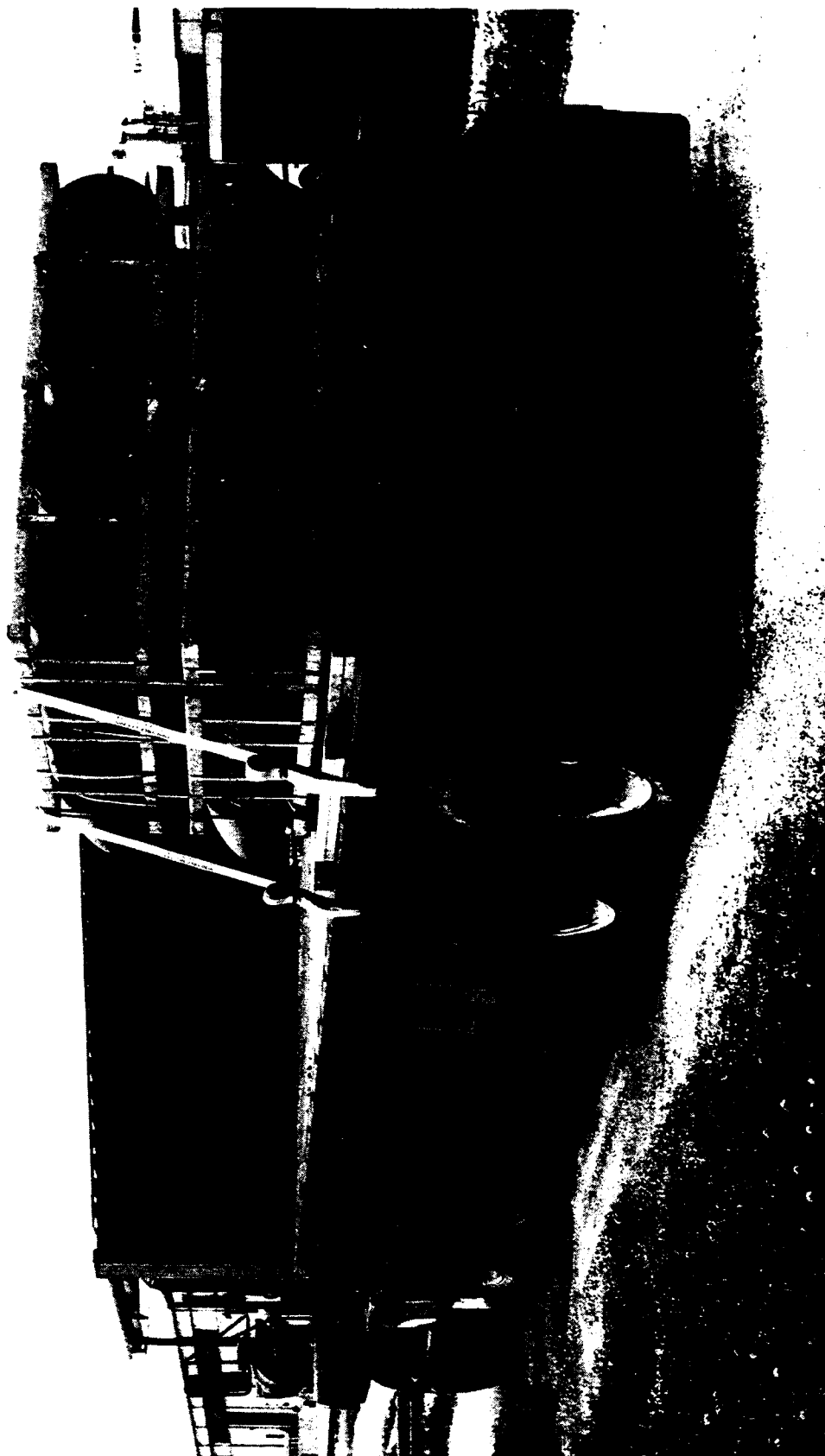
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AO317-SCN-94-047-3102. This photo shows the LANCE M599 load restrained with chains and load binders with rejected fire hose used to replace dunnage.



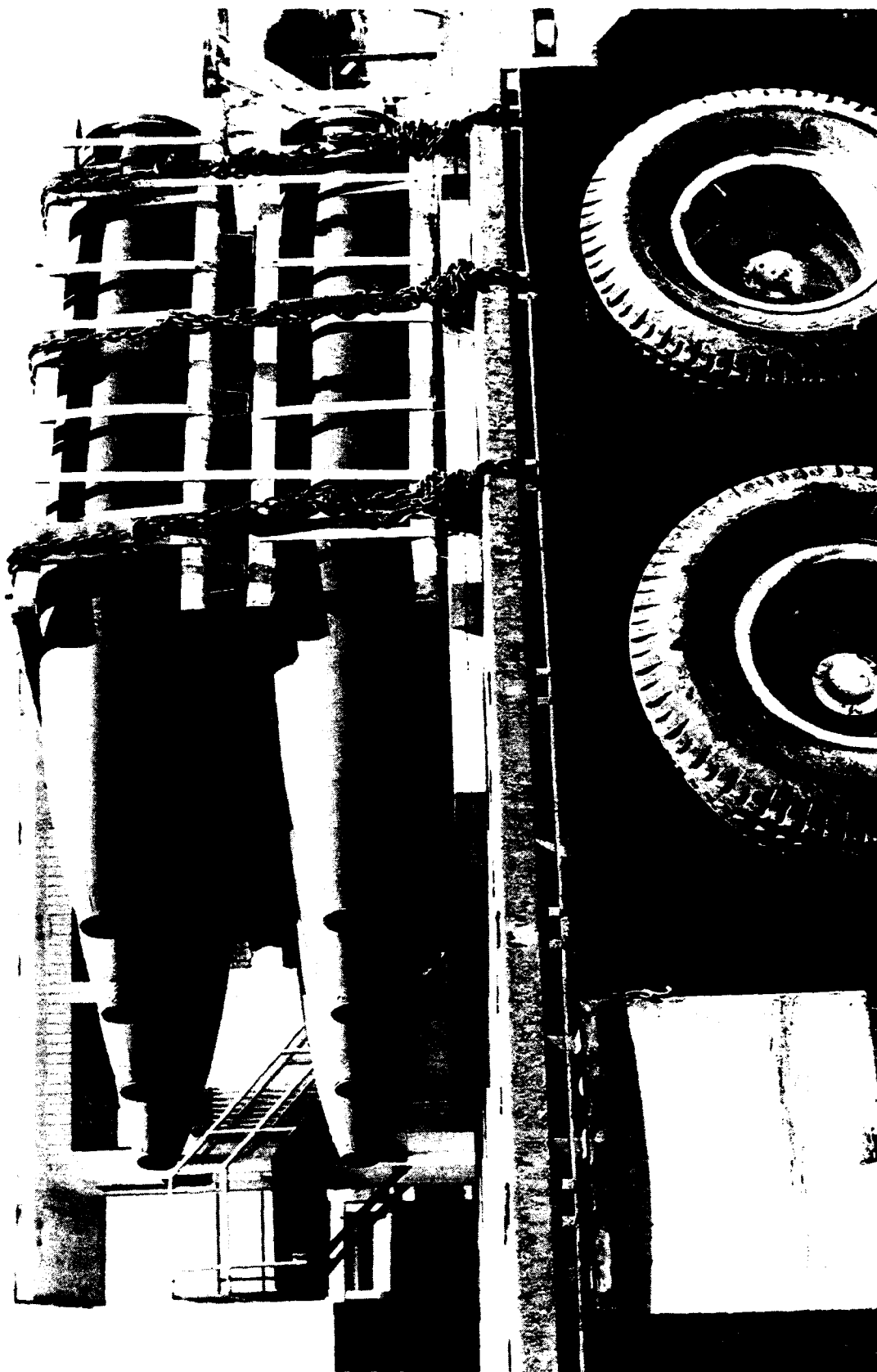
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AO317-SCN-94-047-3061. This photo shows the 2,000-pound bomb load restrained with commercial web strap assemblies.



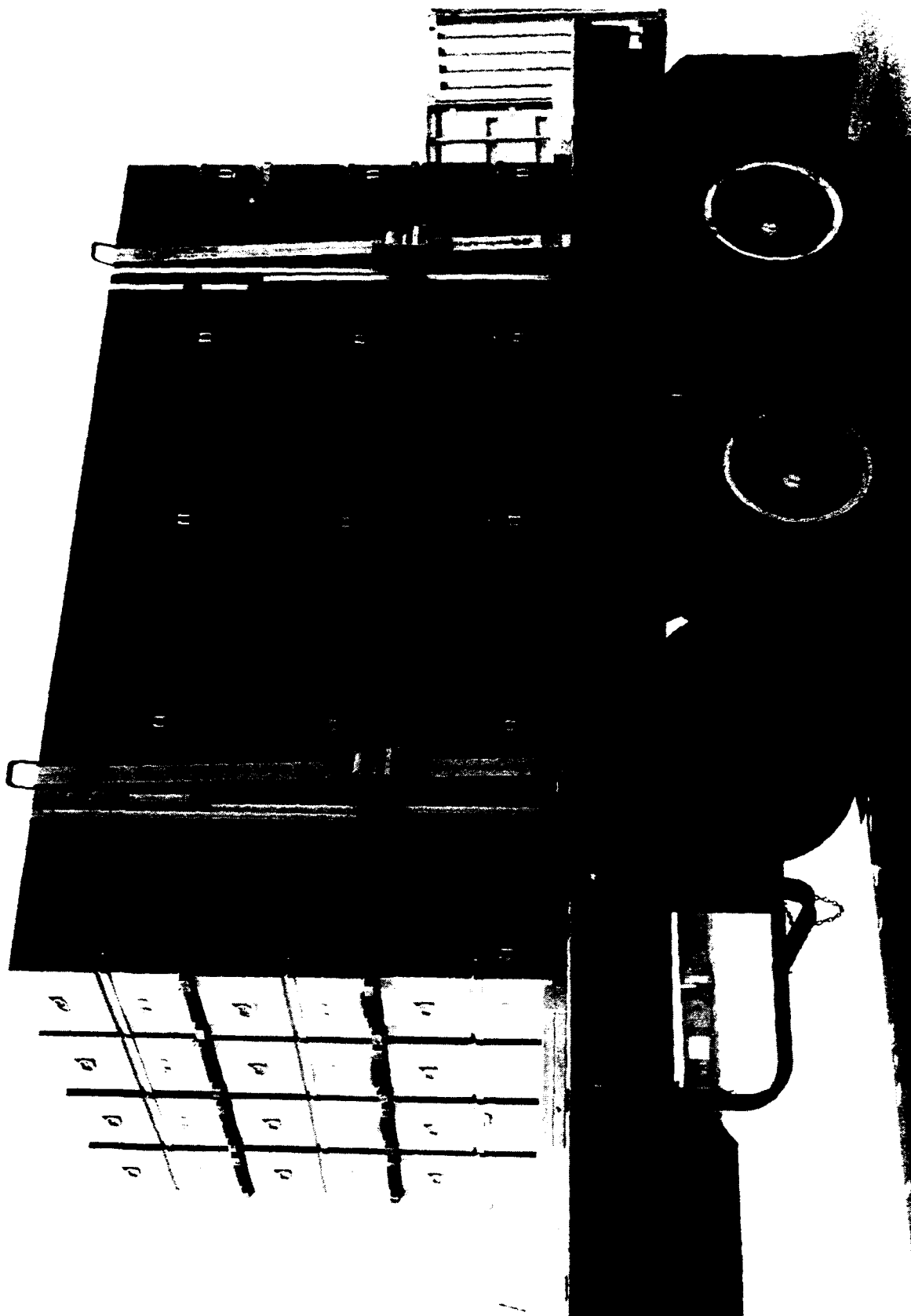
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3066. This photo shows the 2,000-pound bomb load restrained with commercial tiedown straps with winches.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3088. This photo shows the 2,000-pound bomb load restrained with chains and load binders with rejected fire hose used to replace dunnage.



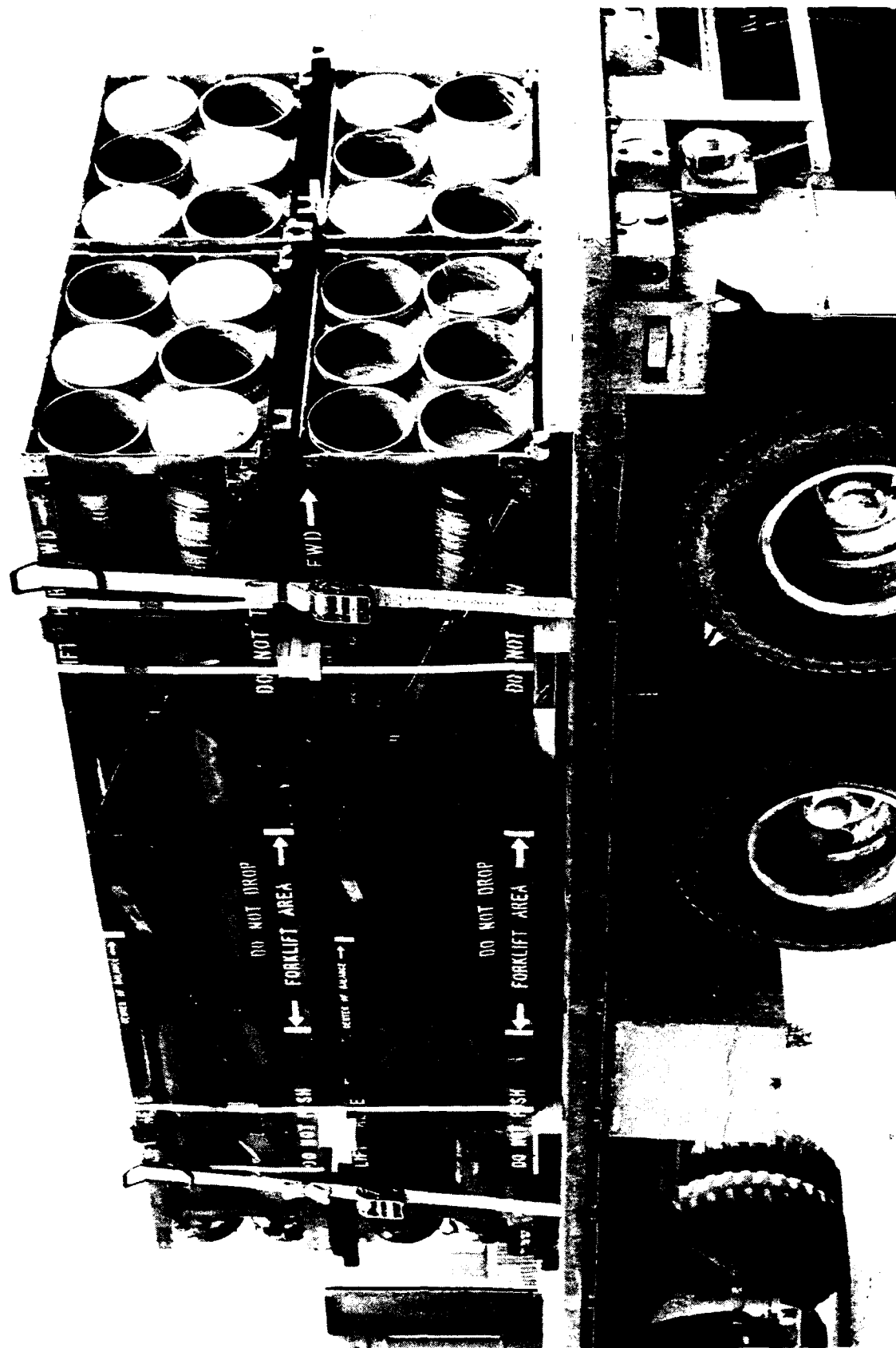
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3096. This photo shows the CNU-123/E load restrained with commercial web strap assemblies.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3083. This photo shows the CNU-123/E load restrained with commercial tiedown web straps with winches.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN-94-047-3141. This photo shows a load of MLRS pods restrained with commercial web strap assemblies.